THE NITROGEN STATUS OF SASKATCHEWAN SOILS

A LONG-TIME SUMMARY

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The NO_3-N data collected in the Saskatchewan Soil Testing Laboratory provides an excellent basis for assessing the nitrogen status and supplying power of Saskatchewan soils in relation to crop production. A variety of interim summaries and reports on this subject have been made available during the nine-year history of the laboratory. However, a comprehensive review of the nitrogen data with a view to providing background material for extension on the subject has not been undertaken. This paper includes the highlights of such a review as well as the tabulated data for future reference.

The basic objective of the study was to document the NO_3-N levels in Saskatchewan summerfallow and stubble fields as they relate to supplemental fertilizer nitrogen requirements. Annual variation in these requirements and the effect of soil zone and surface texture were also considered. The nitrogen supplying power of Saskatchewan soils as estimated by the apparent difference between fallow and stubble NO_3-N levels, was also examined.

Interpretation of the Data

The nitrate data was summarized by calculating two types of information: (1) the distribution of fields sampled into nitrogen availability categories; and (2) the average NO_3-N content to 24 inches. The data were grouped at the soil zone and soil association level as well as into surface texture groups. These data are given in Tables 1 and 2 and illustrated graphically in Figures 1 to 13. Distribution data are more meaningful than average NO_3-N levels since they are related to sufficiency status.

Nitrogen Status Relative to Cereal Production

The available nitrogen status of summerfallow fields in Saskatchewan contrasts sharply with that of stubble fields, as would be expected. However, the proportion of deficient fields increases in the sequence Brown to Gray for both fallow and stubble fields (Fig. 1). Actual NO_3-N levels are highest in the Thick Black soil zone and lowest in the Brown and Gray zones for both soil conditions.

Annual variation in available nitrogen levels is of major interest since it determines the sampling intensity required to accurately assess this parameter. The amount of annual variation can best be evaluated by examining the fluctuations in distribution within the availability categories. The standard deviation of the mean percentage of fields requiring additional nitrogen for the nine-year period (Table 3) provides a measure of annual variation as does the range in this value. Both the standard deviation and range increased in the sequence Brown to Gray for summerfallow indicating that annual variation in NO_3-N levels increases in this sequence for summerfallow. The opposite trend was noted for stubble. These data indicate that the fluctuation in fertilizer nitrogen recommendations will be highest on Gray-Black and Gray summerfallow fields and Brown, Dark Brown and Thin Black stubble fields.

The NO_3-N levels to 24 inches did not fluctuate randomly from year to year as might be deducted from the random nature of the distribution statistics. Trends were apparent in 3 to 5 year intervals on both fallow and stubble in most soil zones. This suggests that NO_3-N mineralization has a cyclic and hysteretic nature. See Figs. 2a, 3a, 4, 5b, and 6a for examples of these trends.

Influence of Soil Texture

The effect of soil texture was examined by segregating the data into three groups on the basis of surface texture. The results (Figs. 8 to 13) indicate that medium-textured (very fine sandy loam to clay loam) soils in the Brown and Black soil zones usually contain higher levels of NO_3-N and are less deficient than coarse (sandy to fine sandy loam) and fine (silty clay loam to heavy clay) textured soils. Surface texture does not appear to influence NO_3-N levels and sufficiency status in Gray-Black and Gray stubble fields but has an effect on summerfallow fields.

Coarse-textured summerfallow fields in these zones were more deficient in nitrogen than medium-textured soils which, in turn, were more deficient than fine-textured soils. This relationship was most apparent in the Gray soil zone. Leaching of NO_3-N is the most probable mechanism responsible for the difference.

Nitrogen Supplying Power

An estimate of the apparent amounts of nitrogen mineralized during the summerfallow period can be obtained by subtracting the NO_3-N levels in stubble from those in fallow. These data are depicted in Fig. 14 at the soil zone level. The net amounts of NO_3-N released are related to the organic matter content of the respective soils. It should be noted that these are net values which have not been corrected for loss mechanisms which would be important in all zones.

Variation in NO_3-N Levels Between Fields

A measure of the variation in NO_3-N levels to 24 inches between fields within a given year is available in the standard deviation values for mean

NO_3-N data. The mean standard deviation of the yearly mean NO_3-N levels for summerfallow and stubble are given in Fig. 15. The data indicate that variation between fields within years is related to sample source. Variation in NO_3-N levels in summerfallow fields was generally higher than in stubble with the greatest amount of variation occurring in the Thick Black soil zone. Variation in NO_3-N contents of stubble fields was lowest in the Brown and Gray zones.

Comparing Manitoba and Saskatchewan Nitrate-Nitrogen Levels

The relative NO_3-N levels in similar soils of Manitoba are of interest (Fig. 16). It would appear that NO_3-N levels in summerfallowed Thin Black soils are similar in the two provinces. Average NO_3-N levels in stubble fields in northwestern, central and western Manitoba are consistently lower than levels in the Thin Black zone of Saskatchewan. This difference is likely an expression of the longer rotation practised in Manitoba resulting in lower residual NO_3-N levels in stubble fields.

Potential Fertilizer Nitrogen Requirements

The potential fertilizer nitrogen requirements for annual crops on various land use patterns can be estimated on the basis of these data. Two land use patterns are of particular interest: (1) the current pattern based on Statistics Canada 1964 to 1972 records (Pattern A) and; (2) the level of use suggested by Rennie in recent discussions (Pattern B) on the practice of summerfallowing. The details of these two systems are given in Table 4. The detailed fertilizer nitrogen requirements for the stubble and fallow under land use patterns A and B are given in Tables 5 to 8 and summarized in Tables 9 and 10. Under

the present cropping system (Pattern A) approximately 96,000 tons of actual nitrogen could be used annually for cereal crops. Of this amount 15,000 tons could be applied to summerfallow.

If summerfallow acreages were reduced to approximately 12,000,000 acres by increasing crop rotation lengths to those given in Table 4, the potential nitrogen use level increases to 242,000 tons. These figures exclude nitrogen use on forages.

Since total annual nitrogen use in Saskatchewan has not exceeded 50,000 tons in the past, it is apparent that current levels of nitrogen use represent a small fraction of the potential level.

Summary and Conclusions

The nitrogen status of Saskatchewan soils relative to cereal crop production can be accurately assessed from data collected in the Saskatchewan Soil Testing Laboratory. A measure of the variation within and across years and zones is also available. Potential fertilizer nitrogen requirements can be calculated and were found to be well in excess of past and current levels of use.

DISCUSSION

Question: Should nitrogen be tested for on an annual basis for all fields (stubble and summerfallow)?

Answer: May consider testing nitrate on summerfallow every year in grey or grey-black soils.

TABLE 1. The nitrogen status of summerfallow fields in Saskatchewan as expressed by distribution of fields sampled into nitrogen availability categories.

Soil Zone	Year Samples Were Taken (Fall of)	No. of Fields	Per Cent of Fields Sampled And N Availability Category						Mean NO_3-N Level in lb/Ac	% of Fields Sampled Requiring Additional Nitrogen
			0-10	11-20	21-30	31-40	41-50	51+		
BROWN										
Fertilizer N Recommended (lb/Ac)			30	15	0	0	0	0		
	1966	721	0.4	3.5	6.1	8.4	14.0	64.5	66.7 ± 33.4	3.9
	1967	1646	0.3	2.0	8.3	20.0	20.0	49.3	56.8 ± 32.8	2.3
	1968	1443	0.8	3.0	7.8	13.7	17.9	56.8	61.0 ± 32.9	3.8
	1969	43	0.0	0.0	4.7	4.7	23.3	67.4	70.1 ± 26.9	0.0
	1970	66	0.0	0.0	9.0	10.4	14.9	65.7	66.1 ± 31.4	0.0
	1971	67	0.0	3.0	1.5	4.5	10.4	80.6	86.9 ± 61.5	3.0
	1972	190	0.0	1.1	1.1	4.7	13.7	79.5	81.1 ± 50.3	1.1
	1973	293	0.0	0.4	1.3	4.8	9.2	84.3	81.0 ± 31.8	0.4
	1974	155	0.0	0.9	0.9	2.6	9.6	86.1	86.1 ± 52.9	0.9
	All Years	4624	0.2	1.5	4.5	7.8	14.8	70.8	72.9 ± 11.2	1.7
DARK BROWN			45	30	15	0	0	0		
	1966	1684	0.7	2.3	4.0	7.5	12.2	73.3	77.0 ± 48.9	7.0
	1967	2551	0.3	1.6	5.6	11.6	15.9	65.0	67.3 ± 37.7	7.5
	1968	1767	0.5	2.9	7.5	12.0	14.3	62.8	65.5 ± 34.5	10.9

TABLE 1 (cont'd)

Soil Zone	Year Samples Were Taken (Fall of)	No. of Fields	Per Cent of Fields Sampled and N Availability Category						Mean NO_3-N Level in lb/Ac	% of Fields Sampled Requiring Additional Nitrogen
			0-10	11-20	21-30	31-40	41-50	51+		
	1969	156	0.0	0.0	4.5	9.6	11.5	74.5	69.7 ± 28.1	4.5
	1970	159	0.0	0.6	3.8	5.7	10.7	79.2	77.6 ± 39.2	4.4
	1971	161	0.0	0.6	1.9	3.7	8.1	85.7	80.3 ± 30.4	2.5
	1972	432	0.0	0.5	1.4	3.2	6.3	88.7	88.3 ± 54.6	1.9
	1973	510	0.0	1.1	0.3	1.1	7.7	89.9	79.6 ± 26.9	1.4
	1974	257	0.0	1.0	1.6	1.0	5.2	91.1	90.9 ± 38.0	2.6
	All Years	7677	0.2	1.2	3.4	6.2	10.2	78.9	77.4 ± 8.8	4.8
THIN BLACK										
Fertilizer N Recommended (lb/Ac)			60	45	30	15	0	0		
	1966	838	0.1	1.0	1.7	3.8	8.5	85.0	92.9 ± 56.0	6.6
	1967	1301	0.0	0.8	1.8	4.5	8.9	83.9	86.2 ± 47.0	7.1
	1968	811	0.1	1.0	3.1	4.1	9.5	82.3	84.3 ± 40.0	8.3
	1969	122	0.8	0.0	3.3	9.8	13.1	73.0	73.1 ± 33.9	13.9
	1970	91	0.0	2.2	3.3	11.0	9.9	73.6	78.5 ± 42.4	16.5
	1971	112	0.0	0.0	1.8	2.7	7.1	88.4	93.4 ± 39.1	4.5
	1972	245	0.0	0.0	0.8	3.7	8.6	86.9	91.1 ± 36.1	4.5
	1973	357	0.0	0.8	2.0	3.3	4.5	89.4	86.9 ± 34.2	6.1
	1974	231	0.0	1.2	2.4	2.4	4.1	89.9	91.3 ± 39.9	6.0
	All Years	4108	0.1	0.8	2.2	5.0	8.2	83.6	86.4 ± 6.9	8.1

TABLE 1 (cont'd)

Soil Zone	Year Samples Were Taken (Fall of)	No. of Fields	Per Cent of Fields Sampled and N Availability Category						Mean NO_3-N Level in lb/Ac	% of Fields Sampled Requiring Additional Nitrogen
			0-10	11-20	21-30	31-40	41-50	51+		
THICK BLACK										
Fertilizer N Recommended (lb/Ac)			75	60	45	30	15	0		
	1966	257	0.4	0.8	1.2	2.3	4.2	91.1	113.1 ± 58.6	8.9
	1967	156	0.0	0.0	1.3	0.6	1.9	96.2	115.7 ± 64.1	3.8
	1968	128	0.0	0.0	1.6	0.0	1.6	96.9	125.7 ± 50.1	3.2
	1969	25	0.0	0.0	4.0	4.0	12.0	80.0	75.6 ± 28.3	20.0
	1970	64	0.0	1.6	0.0	1.6	7.8	89.1	94.4 ± 42.6	11.0
	1971	63	0.0	0.0	1.6	0.0	6.3	92.1	108.9 ± 43.4	7.9
	1972	129	0.0	0.0	0.8	3.1	2.3	93.8	109.3 ± 47.0	6.2
	1973	108	0.0	0.0	0.0	0.0	4.8	95.2	103.9 ± 44.3	4.8
	1974	53	0.0	0.0	2.4	2.4	7.1	88.1	84.4 ± 28.5	11.9
	All Years	983	0.0	0.3	1.4	1.6	5.3	91.4	103.4 ± 15.9	8.6
GRAY BLACK			75	60	45	30	15	0		
	1966	363	1.9	1.9	3.8	7.6	5.4	79.3	85.9 ± 47.3	20.7
	1967	553	0.0	2.2	3.6	5.6	9.7	78.9	88.4 ± 66.8	21.1
	1968	331	0.9	1.5	4.8	7.9	13.9	70.9	77.0 ± 48.7	29.1
	1969	94	0.0	7.4	11.7	8.5	6.4	66.0	72.2 ± 53.5	34.0
	1970	126	0.0	3.2	4.8	4.0	20.0	68.0	77.1 ± 48.6	32.0
	1971	185	0.0	2.7	3.2	7.6	10.3	76.2	80.1 ± 45.3	23.8

TABLE 1 (cont'd)

Soil Zone	Year Samples Were Taken (Fall of)	No. of Fields	Per Cent of Fields Sampled and N Availability Category						Mean NO_3-N Level in lb/Ac	% of Fields Sampled Requiring Additional Nitrogen
			0-10	11-20	21-30	31-40	41-50	51+		
	1972	394	0.3	0.8	2.6	7.4	5.9	83.2	82.0 ± 37.6	16.8
	1973	320	0.5	1.1	3.7	7.9	13.2	73.7	73.8 ± 36.7	26.3
	1974	158	2.5	1.2	1.2	2.5	12.5	80.0	76.0 ± 35.5	20.0
	All Years	2524	0.7	2.2	4.4	6.6	10.8	75.1	79.2 ± 5.4	24.7
GRAY										
Fertilizer N Recommended (lb/Ac)			75	60	45	30	0	0		
	1966	141	1.4	3.5	5.0	9.2	13.5	67.4	77.6 ± 54.8	32.6
	1967	160	1.3	3.8	10.1	14.5	13.2	57.2	58.2 ± 30.0	42.8
	1968	90	1.1	6.5	19.6	21.7	14.1	37.0	49.9 ± 38.0	63.0
	1969	10	0.0	20.0	0.0	0.0	0.0	80.0	75.6 ± 63.8	20.0
	1970	17	0.0	0.0	0.0	29.4	17.6	52.9	56.5 ± 22.6	47.1
	1971	20	0.0	0.0	5.0	10.0	5.0	80.0	71.3 ± 34.1	20.0
	1972	70	0.0	2.9	8.7	5.8	11.6	71.0	78.6 ± 49.8	29.0
	1973	96	1.8	3.5	7.0	29.8	12.3	45.6	54.4 ± 24.8	54.4
	1974	38	4.3	0.0	0.0	13.0	0.0	82.6	71.1 ± 35.0	17.4
	All Years	642	1.1	4.5	6.2	14.8	9.7	63.7	65.9 ± 11.1	36.3

TABLE 2. The nitrogen status of stubble fields in Saskatchewan as expressed by distribution of fields sampled into nitrogen availability categories.

Soil Zone	Year Samples Were Taken (Fall of)	No. of Fields	Per Cent of Fields Sampled And N Availability Category						Mean NO_3-N Level in lb/Ac	% of Fields Sampled Requiring Additional Nitrogen
			0-15	16-30	31-45	46-60	61-75	76+		
BROWN										
Fertilizer N Recommended (lb/Ac)			30	15	0	0	0	0		
	1966	448	45.6	25.7	13.4	6.9	3.4	4.9	27.7 ± 35.1	71.3
	1967	930	8.0	29.9	26.5	16.6	8.5	10.5	44.0 ± 31.1	37.9
	1968	638	14.2	34.6	21.7	14.3	6.4	8.8	39.3 ± 29.5	48.8
	1969	21	4.5	36.4	9.1	31.8	4.5	13.6	45.0 ± 25.7	40.9
	1970	22	22.7	27.3	31.8	9.1	4.5	4.5	32.8 ± 22.0	50.0
	1971	34	5.9	32.4	26.5	8.8	11.8	14.7	43.1 ± 26.5	38.3
	1972	91	5.5	29.7	30.8	18.7	5.5	9.9	43.4 ± 25.4	35.2
	1973	224	3.1	21.2	23.7	16.9	15.6	19.4	55.6 ± 37.2	24.3
	1974	129	11.1	30.2	30.2	11.1	11.1	6.3	41.5 ± 27.6	41.3
	All Years	2537	13.4	29.7	23.7	14.9	7.9	10.3	41.4 ± 7.9	43.1
DARK BROWN			45	30	15	0	0	0		
	1966	1573	30.1	30.7	15.0	8.7	5.1	10.4	36.1 ± 37.6	75.8
	1967	2173	8.2	23.9	24.2	16.3	10.4	17.1	50.5 ± 39.9	56.3

TABLE 2 (cont'd)

Soil Zone	Year Samples Were Taken (Fall of)	No. of Fields	Per Cent of Fields Sampled And N Availability Category						Mean NO_3-N Level in lb/Ac	% of Fields Sampled Requiring Additional Nitrogen
			0-15	16-30	31-45	46-60	61-75	76+		
	1968	1187	12.4	38.2	23.3	11.6	5.6	8.8	40.5 ± 38.7	73.9
	1969	118	4.2	50.0	28.8	11.9	2.5	2.5	35.2 ± 31.2	83.0
	1970	86	10.5	45.3	18.6	10.5	5.8	9.3	40.6 ± 53.3	74.4
	1971	216	16.2	31.5	26.4	14.8	4.2	6.9	38.0 ± 30.3	74.1
	1972	339	13.9	26.8	23.9	14.7	8.8	11.8	44.9 ± 43.3	64.6
	1973	718	7.1	23.0	29.7	18.5	10.6	11.0	45.7 ± 31.8	59.8
	1974	378	7.7	24.5	25.5	24.5	8.7	9.1	44.6 ± 30.9	57.7
	All Years	6752	12.3	32.7	23.9	14.6	6.9	9.7	41.8 ± 5.0	68.9
THIN BLACK										
Fertilizer N Recommended (lb/Ac)			60	45	30	15	0	0		
	1966	1009	25.7	33.3	17.6	8.3	4.8	10.3	39.1 ± 57.6	84.9
	1967	1565	11.6	20.9	17.3	12.6	12.5	25.1	57.3 ± 50.3	62.4
	1968	778	11.3	29.0	25.3	16.1	6.4	11.8	42.9 ± 30.2	81.7
	1969	85	9.4	29.4	21.2	18.8	7.1	14.1	50.9 ± 55.4	78.8
	1970	89	7.9	31.5	27.0	19.1	3.4	11.2	42.6 ± 28.4	85.5
	1971	184	10.3	22.3	25.0	21.2	12.5	8.7	44.5 ± 26.7	78.8
	1972	354	7.3	24.3	25.1	20.1	9.3	13.8	46.8 ± 29.5	76.8
	1973	782	6.0	24.0	28.0	19.9	9.9	12.2	48.7 ± 29.9	77.9

TABLE 2 (cont'd)

Soil Zone	Year Samples Were Taken (Fall of)	No. of Fields	Per Cent of Fields Sampled And N Availability Category						Mean NO_3-N Level in lb/Ac	% of Fields Sampled Requiring Additional Nitrogen
			0-15	16-30	31-45	46-60	61-75	76+		
	1974	392	9.6	23.4	26.1	17.6	8.8	14.6	50.4 ± 34.3	76.7
	All Years	5238	11.0	26.5	23.6	17.1	8.3	13.5	47.0 ± 5.5	78.2
THICK BLACK										
Fertilizer N Recommended (lb/Ac)			75	60	45	30	15	0		
	1966	483	14.4	33.7	23.3	9.8	5.6	13.1	45.9 ± 55.5	86.8
	1967	294	2.4	9.9	12.6	17.7	17.4	39.9	76.1 ± 47.4	60.0
	1968	240	5.0	33.7	26.7	10.8	6.7	17.1	51.9 ± 53.5	82.9
	1969	41	9.8	41.5	19.5	7.3	7.3	14.6	45.2 ± 40.5	85.4
	1970	86	5.9	40.0	28.2	9.4	3.5	12.9	41.1 ± 27.1	87.0
	1971	138	12.3	30.4	21.0	15.9	5.8	14.5	42.7 ± 28.4	85.4
	1972	233	7.3	27.0	29.2	14.2	6.0	16.3	47.8 ± 36.4	83.7
	1973	315	3.4	18.6	29.1	23.2	11.0	14.8	52.3 ± 27.2	85.3
	1974	118	4.6	21.8	28.7	25.3	12.6	6.9	44.9 ± 19.7	93.0
	All Years	1948	7.2	28.5	24.3	14.8	8.4	16.7	49.8 ± 10.6	83.2
GRAY BLACK			75	60	45	30	15	0		
	1966	605	35.9	32.2	14.4	5.6	4.0	7.9	32.8 ± 44.3	92.1
	1967	840	16.5	31.9	17.7	12.2	8.3	13.4	44.8 ± 43.7	86.6
	1968	351	25.3	40.5	19.3	5.5	2.6	6.9	33.2 ± 37.9	93.2

TABLE 2 (cont'd)

Soil Zone	Year Samples Were Taken (Fall of)	No. of Fields	Per Cent of Fields Sampled And N Availability Category						Mean NO_3-N Level in lb/Ac	% of Fields Sampled Requiring Additional Nitrogen
			0-15	16-30	31-45	46-60	61-75	76+		
	1969	59	17.2	43.1	20.7	15.5	1.7	1.7	30.1 ± 16.4	98.2
	1970	125	21.0	33.1	21.8	10.5	3.2	10.5	40.4 ± 40.8	89.6
	1971	193	17.1	34.2	23.3	9.8	7.8	7.8	38.3 ± 33.1	92.2
	1972	364	15.5	40.7	23.0	10.5	4.7	5.5	36.8 ± 38.4	94.4
	1973	504	15.6	38.5	23.3	10.6	4.3	7.6	40.1 ± 34.2	92.3
	1974	319	9.7	44.8	23.4	11.0	9.0	2.1	38.1 ± 29.0	97.9
	All Years	3360	19.3	37.7	20.8	10.1	5.1	7.0	37.2 ± 4.5	93.0
GRAY			75	60	45	30	15	0		
	1966	149	43.2	26.4	17.6	5.4	2.0	5.4	27.5 ± 29.0	94.6
	1967	187	36.4	37.4	10.2	9.6	2.1	4.3	27.1 ± 26.6	95.7
	1968	50	30.0	50.0	12.0	6.0	0.0	2.0	24.5 ± 16.1	98.0
	1969	7	14.3	42.9	42.9	0.0	0.0	0.0	24.9 ± 10.7	100.1
	1970	11	27.3	45.5	9.1	18.2	0.0	0.0	26.5 ± 16.7	100.1
	1971	39	33.3	41.0	12.8	10.3	0.0	2.6	24.4 ± 17.1	97.4
	1972	33	18.2	33.3	30.3	9.1	3.0	6.1	38.3 ± 42.0	93.9
	1973	102	33.3	40.4	19.3	3.5	1.8	1.8	26.2 ± 19.5	98.3
	1974	80	14.0	23.3	34.9	16.3	4.7	7.0	37.8 ± 33.0	93.2
	All Years	658	29.5	37.2	18.3	9.8	1.7	3.7	28.6 ± 5.5	96.5

TABLE 3. The mean, standard deviation and range of per cent of fields sampled requiring additional nitrogen for the period 1966 to 1974 for Saskatchewan.

Soil Zone	Summerfallow			Stubble		
	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range
Brown	1.7	1.5	3.9	43.1	12.2	47.0
Dark Brown	4.8	3.0	9.5	68.9	8.9	26.7
Thin Black	8.2	4.0	12.0	78.2	6.4	23.1
Thick Black	8.6	4.9	16.8	83.3	8.7	13.0
Gray Black	24.7	5.5	17.2	93.0	3.5	11.3
Gray	36.2	15.5	45.6	96.8	2.4	6.9

TABLE 4. Two land use patterns for Saskatchewan.

Pattern A (Statistics Canada 1964-72, Aug.)

Soil Zone	Mean Rotation Length (yr)	Land Use Pattern (Ac x 10^6)			
			Seeded to Annual Crop		
		S.Fallow	on S. Fallow	on Stubble	Total
Brown	2.2	4.422	4.422	0.854	5.277
Dark Brown	2.3	5.770	5.770	1.832	7.602
Thin Black	2.5	3.673	3.673	1.769	5.442
Thick Black	2.5	0.968	0.968	0.508	1.476
Gray Black	2.5	1.498	1.498	0.769	2.267
Gray	2.5	0.389	0.389	0.187	0.576
Totals		16.720	16.720	5.920	22,640

Pattern B (Rennie, 1972)

Soil Zone	Mean Rotation Length (yr)	Land Use Pattern (Ac x 10^6)			
			Seeded to Annual Crop		
		S. Fallow	on S. Fallow	on Stubble	Total
Brown	2.5	3.880	3.880	1.939	5.819
Dark Brown	3.0	4.457	4.457	4.457	8.915
Thin Black	4.0	2.278	2.278	4.556	6.834
Thick Black	5.0	0.488	0.488	1.466	1.955
Gray Black	6.6	0.564	0.564	2.636	3.200
Gray	10.0	0.097	0.097	0.869	0.868
Totals		11.764	11.764	15.832	27.596

TABLE 5. Potential fertilizer nitrogen requirements on stubble in Saskatchewan (Land Use Pattern A).

Soil Zone	Heading	lb Additional N Required 15	30	45	60	75	Totals
Brown (854,000 Ac)	Def. %	29.7	13.4	--	--	--	43.1%
	Def. Ac	254,000	114,000	--	--	--	368,000 Ac
	Ton N	1,905	1,710	--	--	--	3,615 Tons N
Dark Brown (1,832,000 Ac)	%	23.9	32.7	12.3	--	--	68.9%
	Ac	437,848	599,064	225,336	--	--	1,262,248 Ac
	Ton N	3,283	8,985	5,070	--	--	17,338 Tons N
Thin Black (1,769,000 Ac)	%	17.1	23.6	26.5	11.0	--	78.2%
	Ac	302,499	417,484	468,785	194,590	--	1,383,358 Ac
	Ton N	2,268	6,262	10,548	5,838	--	24,916 Tons N
Thick Black (508,000 Ac)	%	8.4	14.8	24.3	28.5	7.2	83.2%
	Ac	42,672	75,184	123,444	144,780	36,576	422,656 Ac
	Ton N	320	1,128	2,777	4,343	1,371	9,940 Tons N
Gray-Black (769,000 Ac)	%	5.1	10.1	20.8	37.7	19.3	93.0%
	Ac	39,219	77,669	159,952	289,913	148,417	715,170 Ac
	Ton N	294	1,165	3,599	8,697	5,565	19,319 Tons N
Gray (187,000 Ac)	%	1.7	9.8	18.3	37.2	29.5	96.5%
	Ac	3,179	18,326	34,221	69,564	55,165	180,455 Ac
	Ton N	24	275	770	2,087	2,068	5,225 Tons N
					Total Fertilizer N	=	80,353 Tons

TABLE 6. Potential fertilizer nitrogen requirements on summerfallow in Saskatchewan (Land Use Pattern A).

Soil Zone	Heading	lb Additional N Required					Totals
		15	30	45	60	75	
Brown	%	1.5	0.2	--	--	--	
(4,422,000 Ac)	Ac	66,330	88,440	--	--	--	154,770 Ac
	Ton N	497	133	--	--	--	630 Tons N
Dark Brown	%	3.4	1.2	0.2	--	--	
(5,777,000 Ac)	Ac	196,418	69,324	11,554	--	--	277,296 Ac
	Ton N	1,473	1,039	260	--	--	2,772 Tons N
Thin Black	%	5.0	2.2	0.8	0.1	--	
(3,673,000 Ac)	Ac	183,650	80,806	29,384	3,673	--	297,513 Ac
	Ton N	1,377	1,212	661	110	--	3,360 Tons N
Thick Black	%	5.3	1.6	1.4	0.3	0.0	
(968,000 Ac)	Ac	51,304	15,488	13,552	2,904	0.0	83,248 Ac
	Ton N	385	232	305	87	0.0	1,009 Tons N
Gray-Black	%	10.8	6.6	4.4	2.2	0.7	
(1,498,000 Ac)	Ac	161,784	98,868	65,912	32,956	10,486	370,006 Ac
	Ton N	1,213	1,483	1,483	988	393	5,560 Tons N
Gray	%	9.7	14.8	6.2	4.5	1.1	
(389,000 Ac)	Ac	37,733	57,572	24,118	17,505	4,279	141,207 Ac
	Ton N	283	863	543	525	160	2,374 Tons N
						Total Fertilizer N =	15,705 Tons

TABLE 7. Potential fertilizer nitrogen requirements on stubble in Saskatchewan (Land Use Pattern B).

Soil Zone	Heading	lb Additional N Required 15	30	45	60	75	Totals
Brown	Def. %	29.7	13.4	--	--	--	43.1%
(1,939,000 Ac)	Def. Ac	575,883	259,826	--	--	--	835,709 Ac
	Ton N	4,319	3,897	--	--	--	8,216 Tons N
Dark Brown	Def. %	23.9	32.7	12.3	--	--	68.9%
(4,457,000 Ac)	Def. Ac	1,065,223	1,457,439	548,211	--	--	3,070,873 Ac
	Ton N	7,989	21,862	12,335	--	--	42,186 Tons N
Thin Black	Def. %	17.1	23.6	26.5	11.0	--	78.2%
(4,556,000 Ac)	Def. Ac	779,076	1,075,216	1,207,340	501,160	--	3,562,792 Ac
	Ton N	5,843	16,128	27,165	15,035	--	64,170 Tons N
Thick Black	Def. %	8.4	14.8	24.3	28.5	7.2	83.2%
(1,466,000 Ac)	Def. Ac	123,144	216,968	356,238	417,810	105,552	1,219,712 Ac
	Ton N	924	3,254	8,015	12,534	3,958	28,685 Tons N
Gray-Black	Def. %	5.1	10.1	20.8	37.7	19.3	93.0%
(2,636,000 Ac)	Def. Ac	134,436	266,236	548,288	993,772	508,748	2,451,480
	Ton N	1,008	3,994	12,336	29,813	19,078	66,229 Tons N
Gray	Def. %	1.7	9.8	18.3	37.2	29.5	96.5%
(869,000 Ac)	Def. Ac	14,773	85,162	159,027	323,268	256,355	838,585 Ac
	Ton N	110	1,277	3,578	9,690	9,613	24,268 Tons N
					Total Fertilizer N	=	233,754 Tons

TABLE 8. Potential fertilizer nitrogen requirements on summerfallow in Saskatchewan (Land Use Pattern B).

Soil Zone	Heading	lb Additional N Required					Totals
		15	30	45	60	75	
Brown	%	1.5	0.2	--	--	--	
(3,880,000 Ac)	Ac	58,200	7,760	--	--	--	65,960 Ac
	Ton N	437	116	--	--	--	553 Tons N
Dark Brown	%	3.4	1.2	0.2	--	--	
(4,457,000 Ac)	Ac	151,538	53,484	8,914	--	--	213,936 Ac
	Ton N	1,136	802	201	--	--	2,139 Tons N
Thin Black	%	5.0	2.2	0.8	0.1	--	
(2,278,000 Ac)	Ac	113,900	90,116	18,224	2,278	--	224,518 Ac
	Ton N	854	752	410	68	--	2,084 Tons N
Thick Black	%	5.3	1.6	1.4	0.3	0.0	
(488,000 Ac)	Ac	25,864	7,808	6,832	1,464	--	41,968 Ac
	Ton N	194	117	154	44	--	509 Tons N
Gray-Black	%	10.8	6.6	4.4	2.2	0.7	
(564,000 Ac)	Ac	60,912	37,224	24,816	12,408	3,948	139,308 Ac
	Ton N	457	558	558	372	148	2,093 Tons N
Gray	%	9.7	14.8	6.2	4.5	1.1	
(97,000 Ac)	Ac	9,409	14,356	6,014	4,365	1,067	35,208 Ac
	Ton N	71	215	135	131	40	592 Tons N
						Total Fertilizer N =	7,970 Tons

TABLE 9. Potential fertilizer nitrogen requirements on the basis of Land Use Pattern A.

Soil Zone	Total Seeded Acreage ($\times 10^{-6}$)	Summerfallow: Deficient Acres ($\times 10^{-6}$)	Summerfallow: Tons Fert. N Req'd.	Stubble: Deficient Acres ($\times 10^{-6}$)	Stubble: Tons Fert. N Req'd.	Total Fert. N Required (Tons)
Brown	5.277	0.155	630	0.368	3.615	4,245
Dark Brown	7.602	0.277	2,772	1.262	17,338	20,110
Thin Black	5.442	0.298	3,360	1.383	24,916	28,276
Thick Black	1.476	0.083	1,009	0.423	9,940	10,949
Gray-Black	2.267	0.370	5,560	0.715	19,319	24,879
Gray	0.576	0.141	2,374	0.180	5,225	7,599
Totals	22.640	1.324	15,705	4.331	80,353	96,058

TABLE 10. Potential fertilizer nitrogen requirements on the basis of Land Use Pattern B.

Soil Zone	Total Seeded Acreage ($\times 10^{-6}$)	Summerfallow: Deficient Acres ($\times 10^{-6}$)	Summerfallow: Tons Fert. N Req'd.	Stubble: Deficient Acres ($\times 10^{-6}$)	Stubble: Tons Fert. N Req'd.	Total Fert. N Required (Tons)
Brown	5.819	0.066	553	0.836	8,216	8,769
Dark Brown	8.915	0.214	2,139	3.071	42,186	44,325
Thin Black	6.834	0.225	2,084	3.563	64,170	66,254
Thick Black	1.955	0.042	509	1.220	28,685	29,194
Gray Black	3.200	0.139	2,093	2.451	66,229	68,322
Gray	0.868	0.035	592	0.839	24,268	24,860
Totals	27.596	0.721	7,970	11.980	233,754	241,724

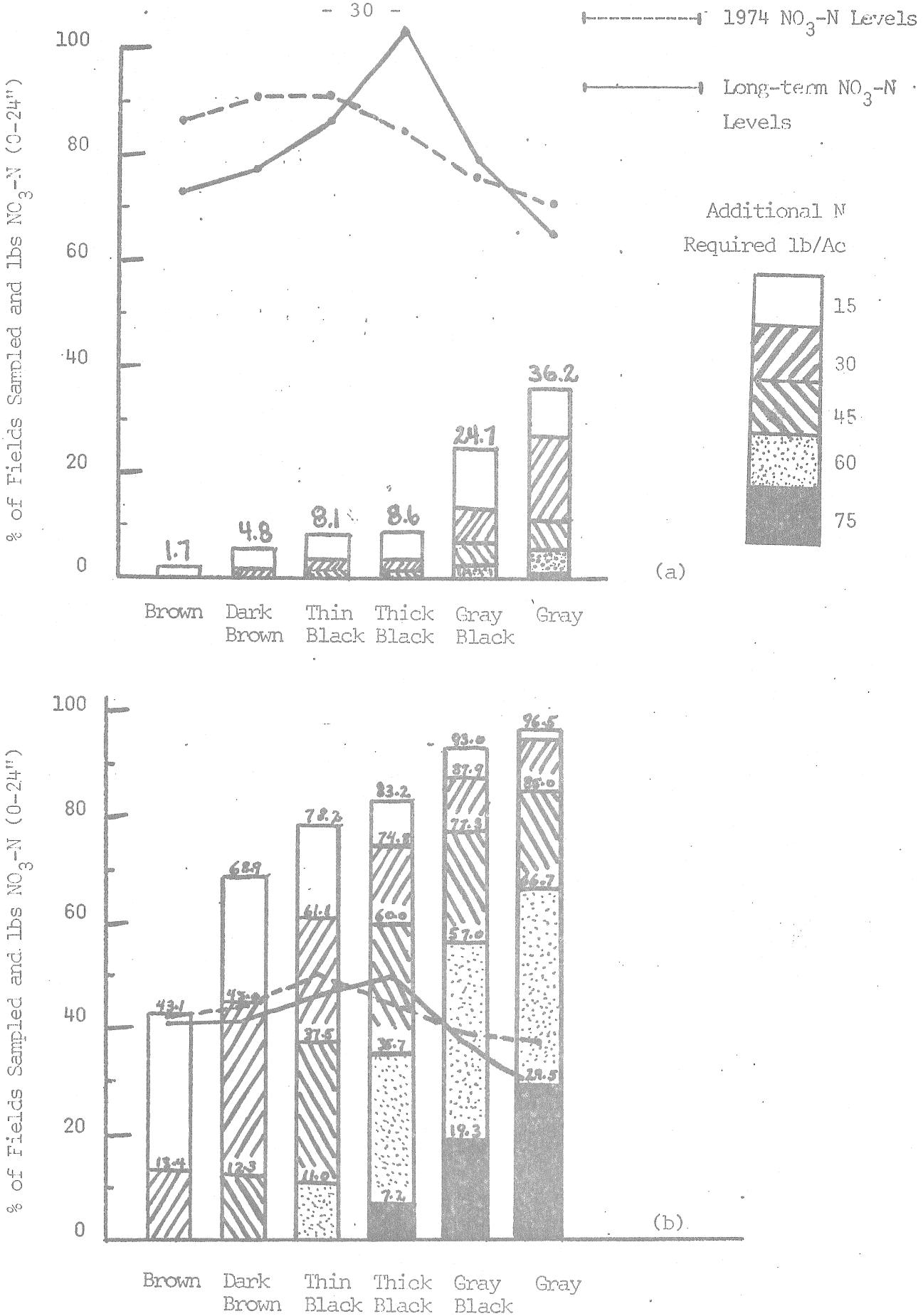

FIGURE 1. The average NO_3-N contents to 24" and degree of nitrogen deficiency of (a) summerfallow and (b) stubble fields in Saskatchewan during the period 1966 to 1974 based on soil test data summaries.

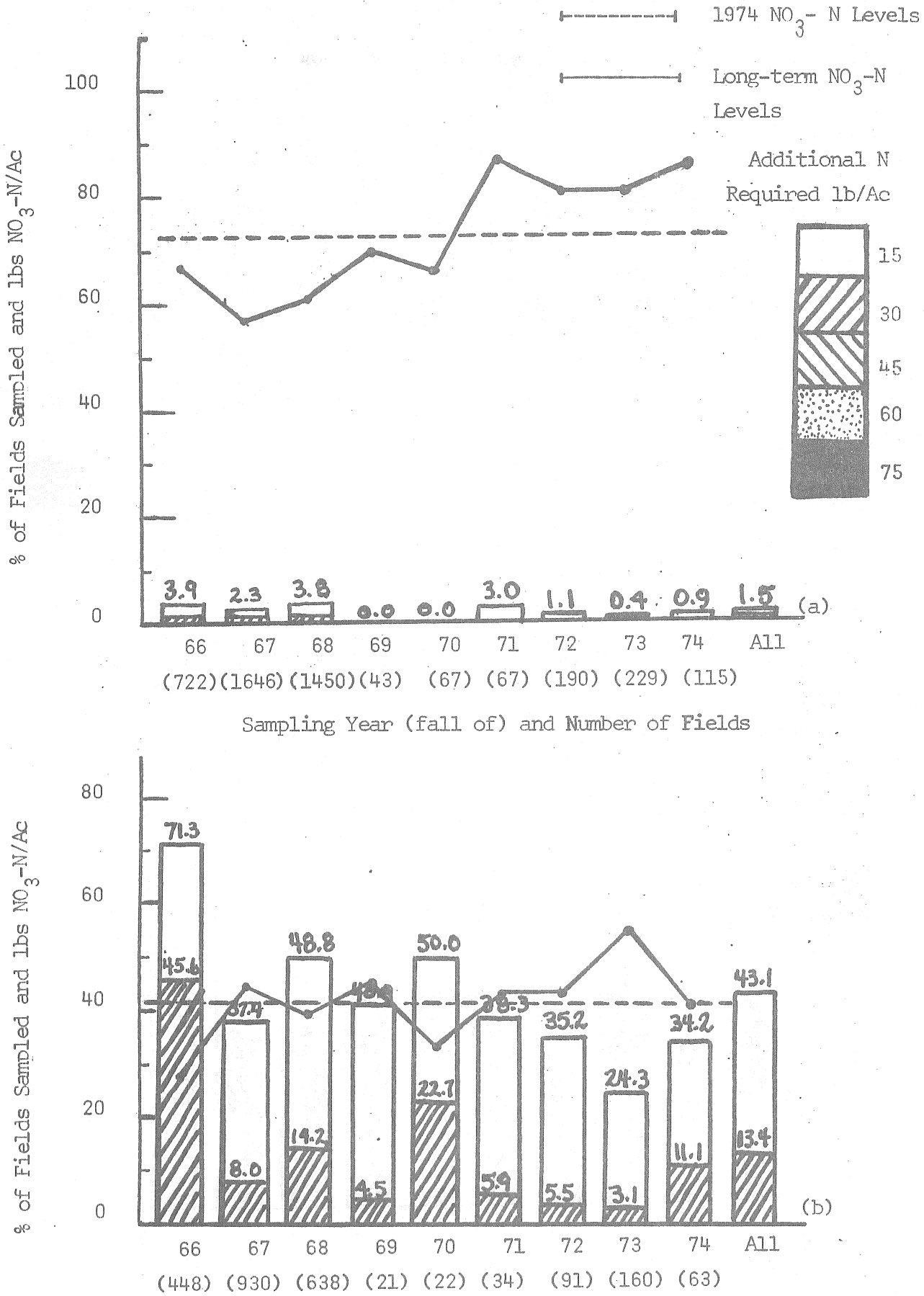

FIGURE 2. The average NO_3-N content to 24" and degree of nitrogen deficiency of (a) summerfallow and (b) stubble fields in the Brown soil zone of Saskatchewan for the period 1966 to 1974. The numbers in the histogram columns are cumulative percentages.

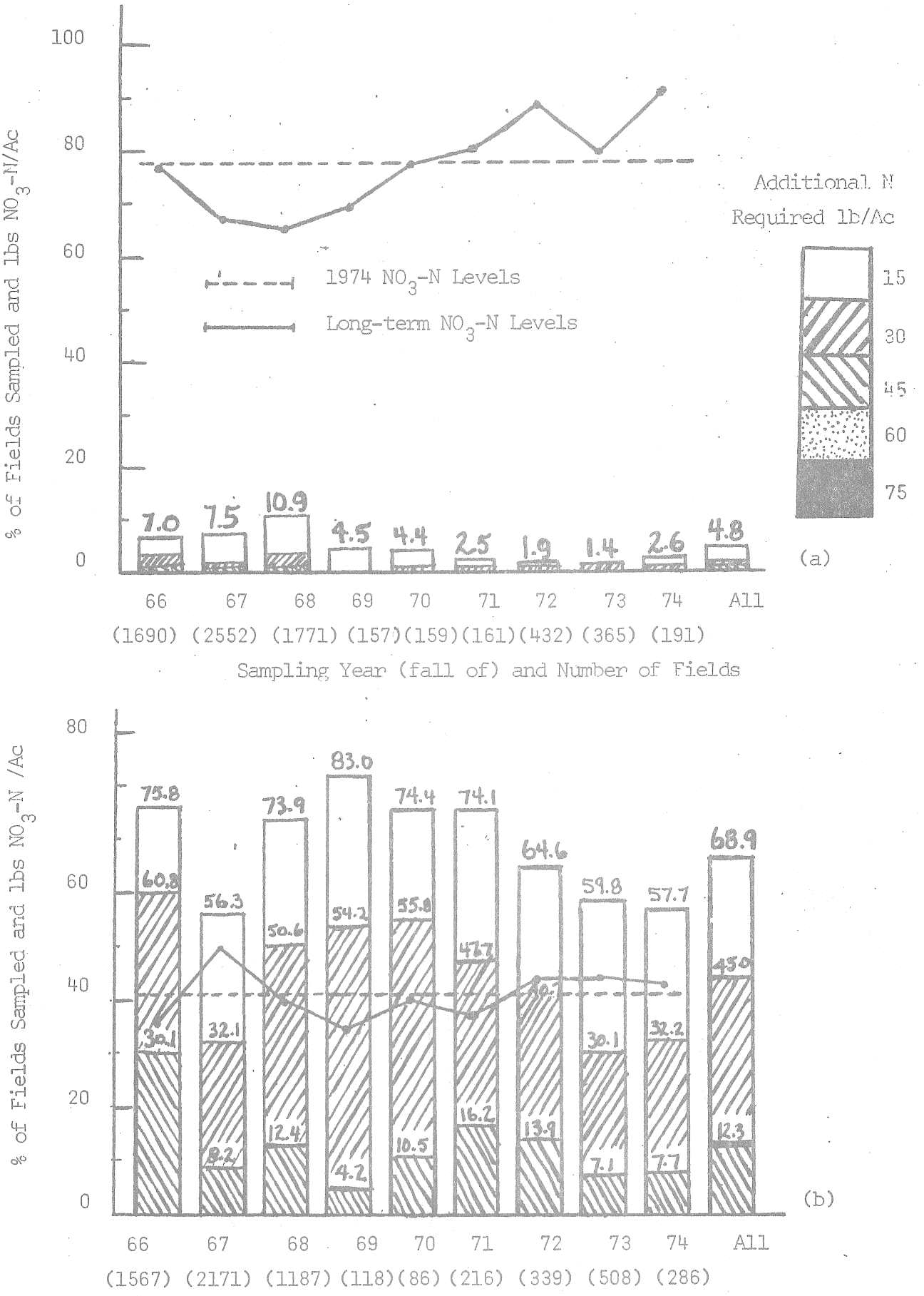

FIGURE 3. The average NO_3-N content to 24" and degree of nitrogen deficiency of (a) summerfallow and (b) stubble fields in the Dark Brown soil zone of Saskatchewan for the period 1966 to 1974. The numbers in the histogram columns are cumulative percentages.

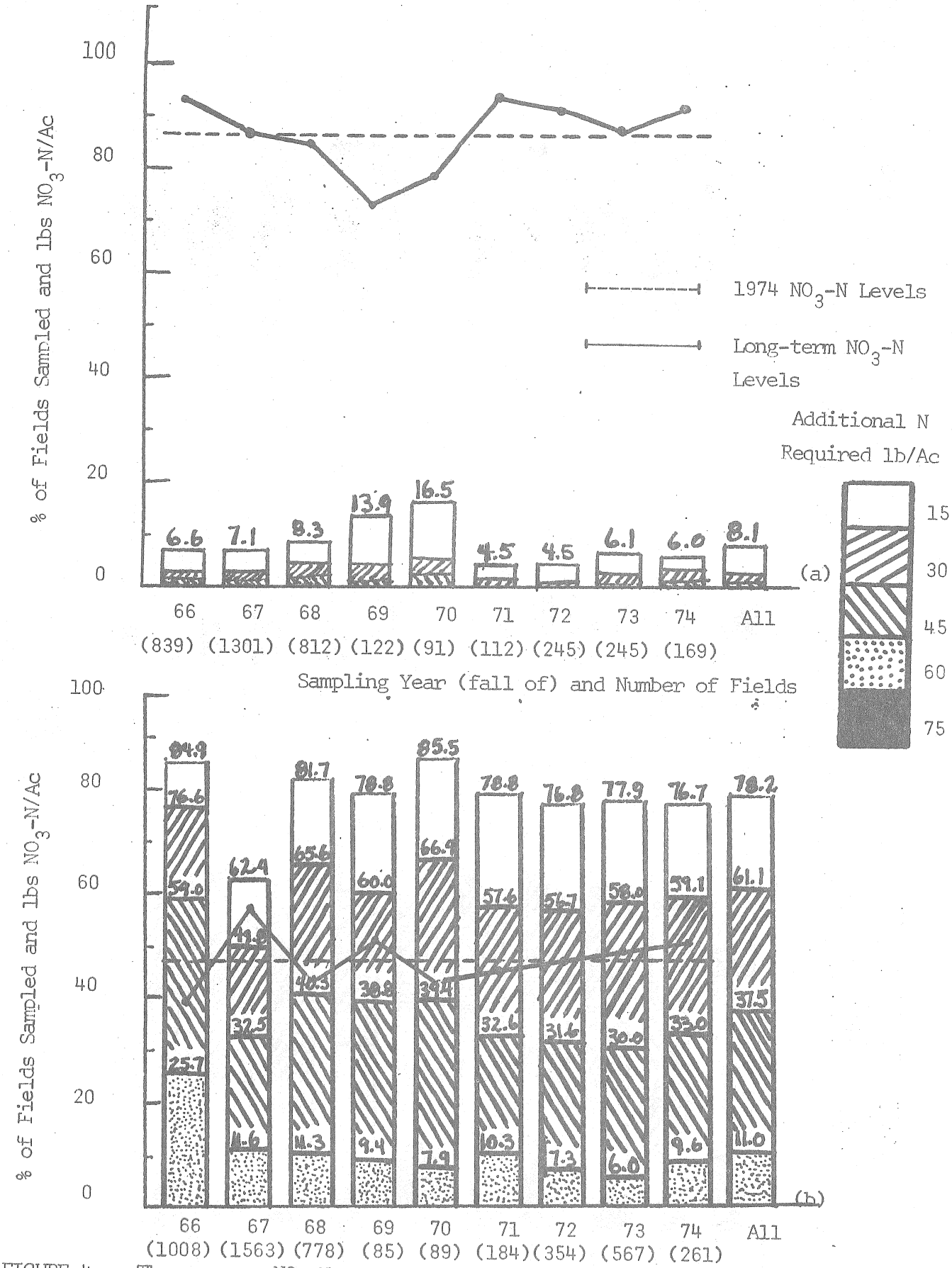

FIGURE 4. The average NO_3-N content to 24" and degree of nitrogen deficiency of (a) summerfallow and (b) stubble fields in the Thin Black soil zone of Saskatchewan for the period 1966 to 1974. The numbers in the histogram columns are cumulative percentages.

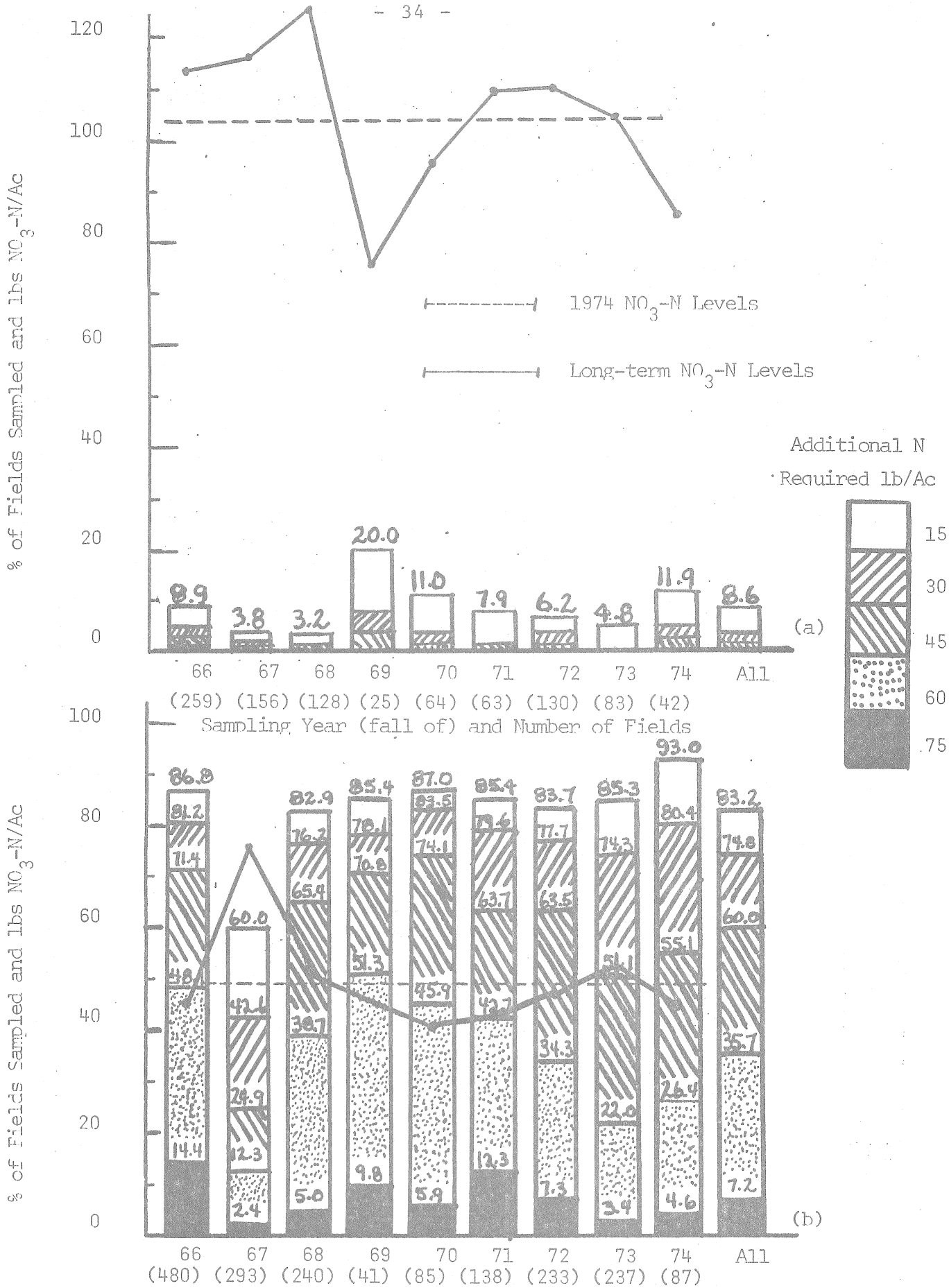

FIGURE 5. The average NO_3-N content to 24" and degree of nitrogen deficiency of (a) summerfallow and (b) stubble fields in the Thick Black soil zone of Saskatchewan for the period 1966 to 1974. The numbers in the histogram columns are cumulative percentages.

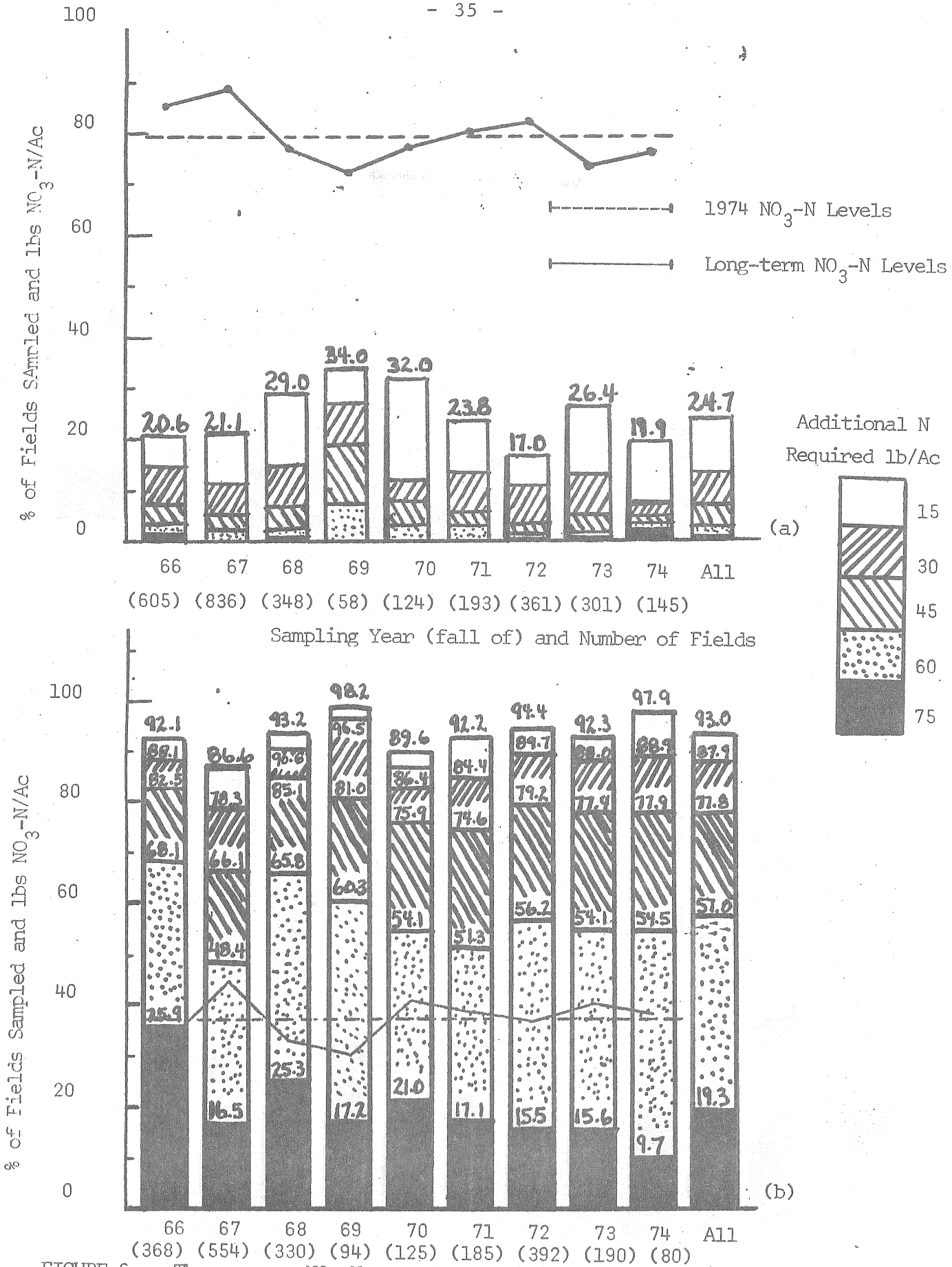

FIGURE 6. The average NO_3-N content to 24" and degree of nitrogen deficiency of (a) summerfallow and (b) stubble fields in the Gray Black soil zone of Saskatchewan for the period 1966 to 1974. The numbers in the histogram columns are cumulative percentages.

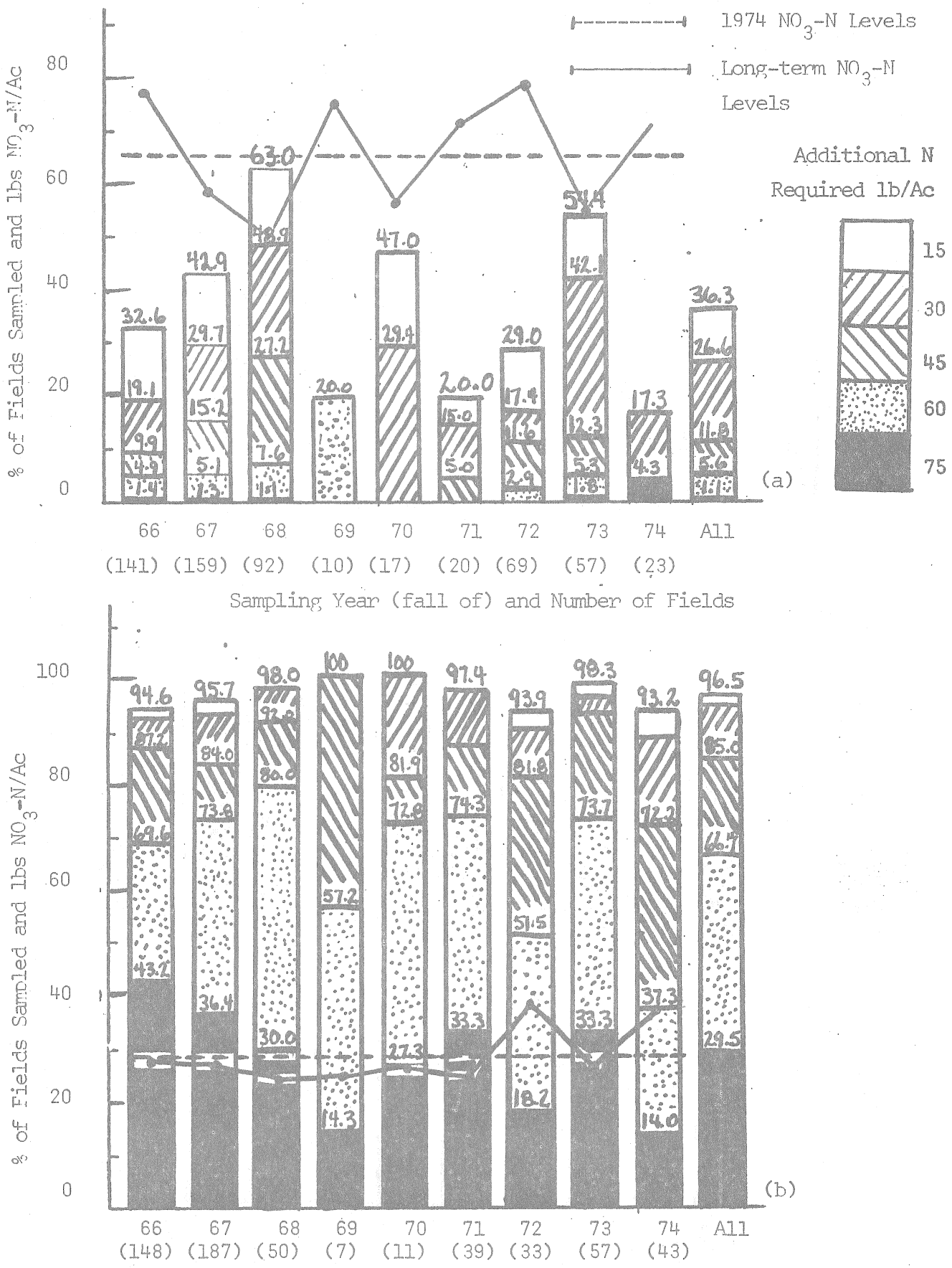

FIGURE 7. The average NO_3-N content to 24" and degree of nitrogen deficiency of (a) summerfallow and (b) stubble fields in the Gray soil zone of Saskatchewan for the period 1966 to 1974. The numbers in the histogram columns are cumulative percentages.

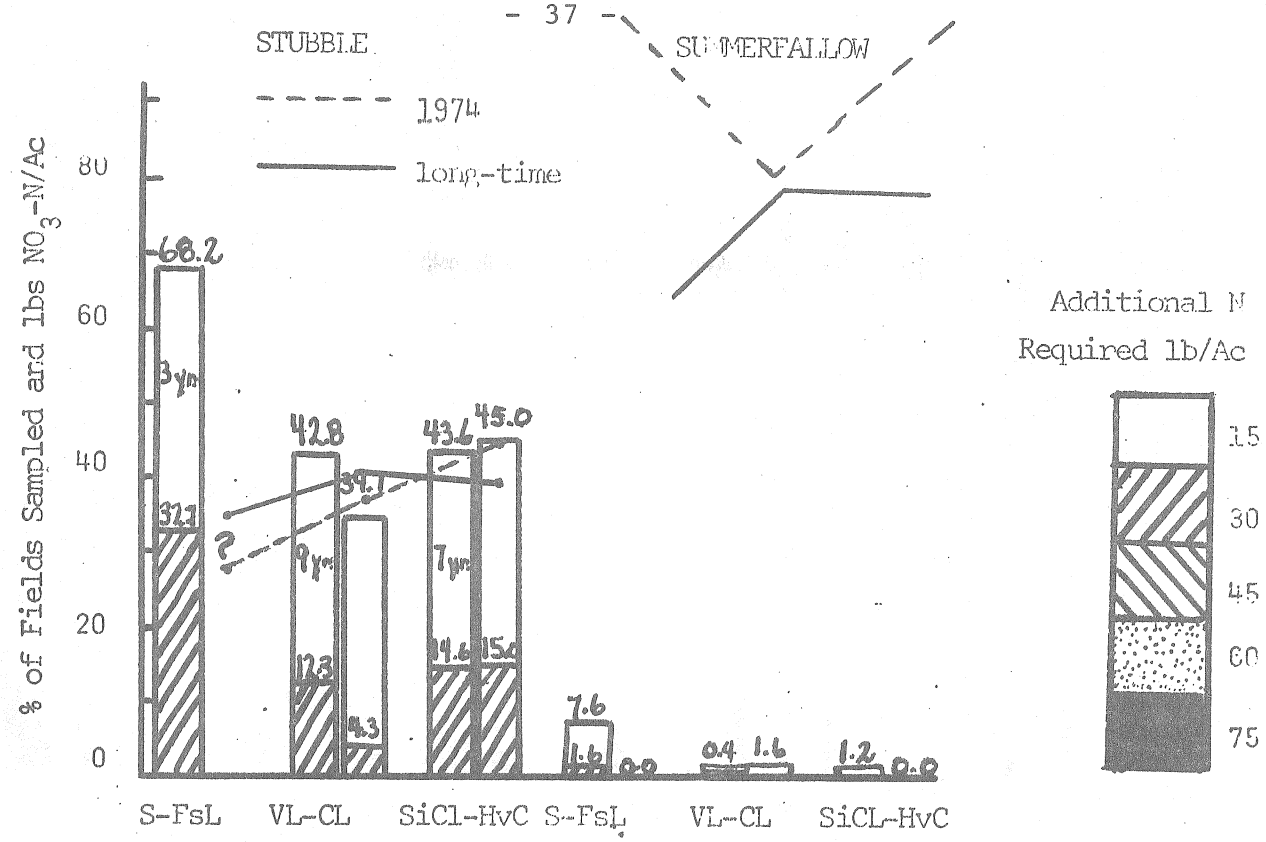

FIGURE 8. The average NO_3-N content to 24" and degree of nitrogen deficiency in Brown soils of Saskatchewan in relation to surface texture. The left-hand column in the pair represents the long-time average and the right-hand column the 1974 situation.

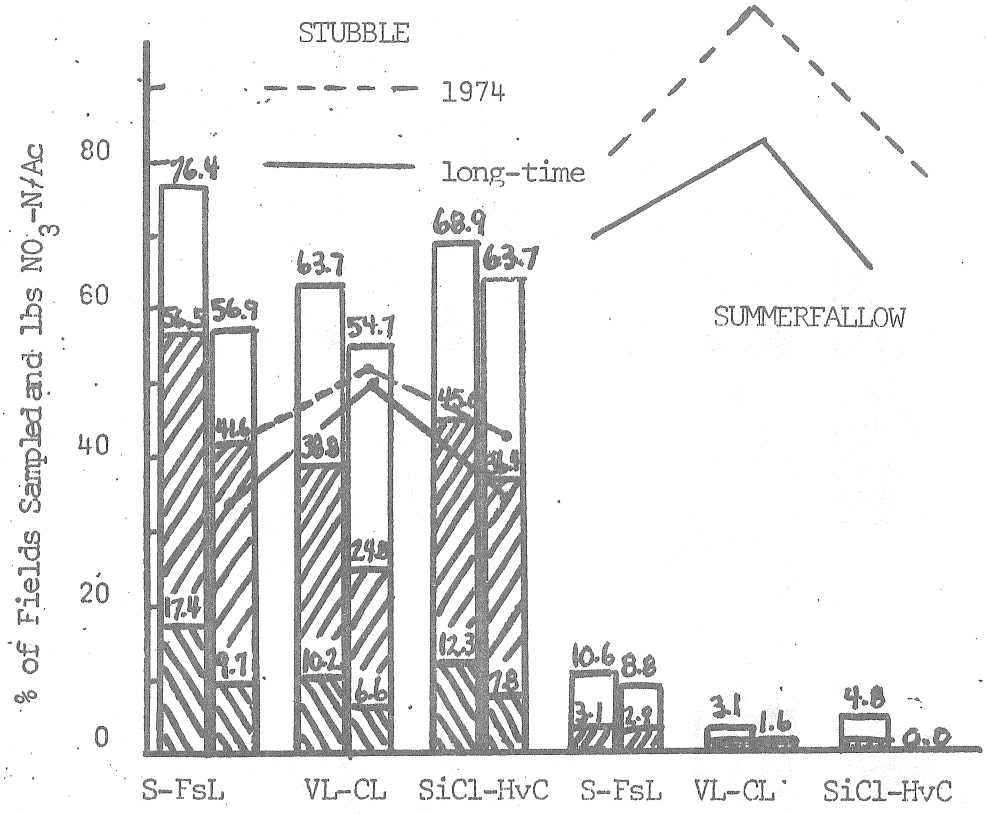

FIGURE 9. The average NO_3-N content to 24" and degree of nitrogen deficiency in Dark Brown soils of Saskatchewan in relation to surface texture. The left-hand column in the pair represents the long-time average and the right-hand column the 1974 situation.

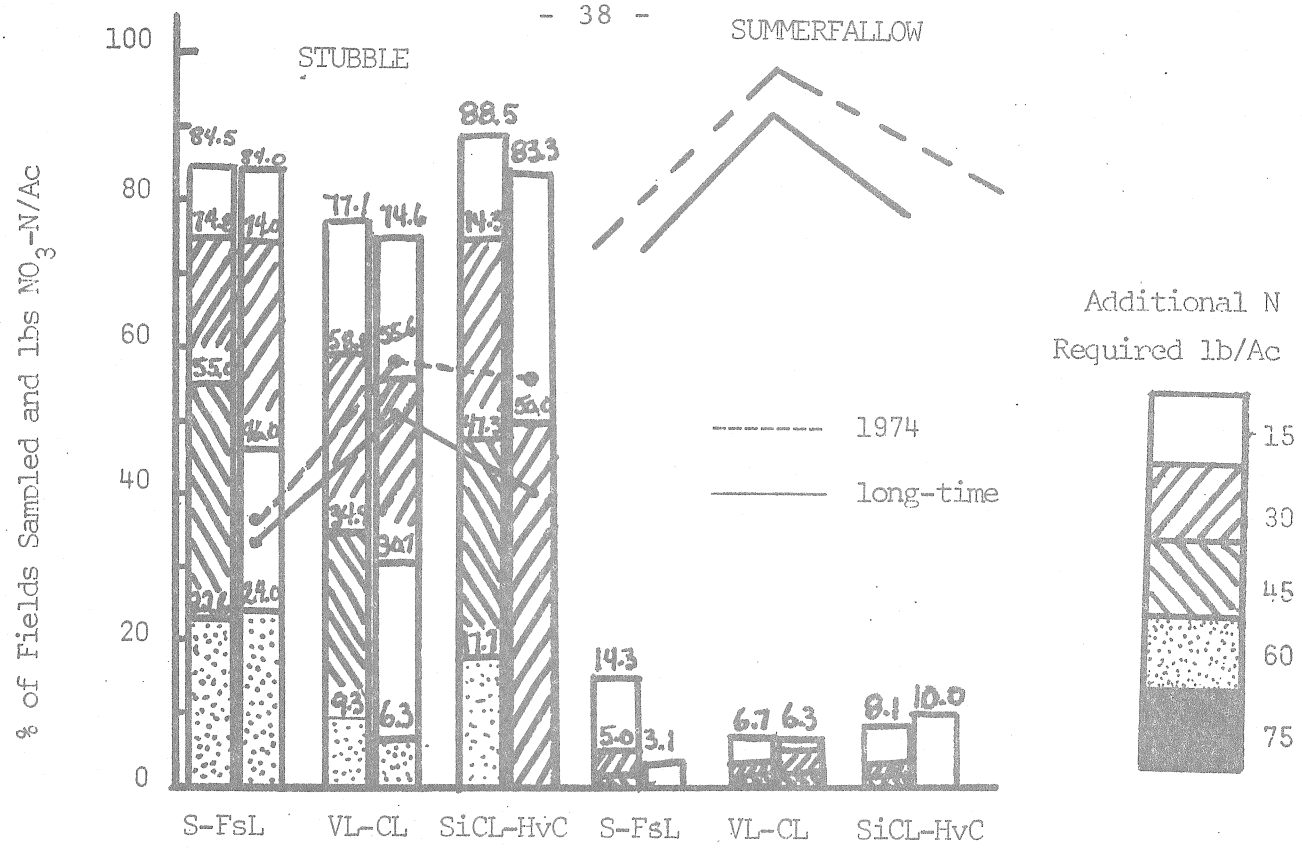

FIGURE 10. The average NO_3-N content to 24" and degree of nitrogen deficiency in Thin Black soils of Saskatchewan in relation to surface texture. The left-hand column in the pair represents the long-time average and the right-hand column the 1974 situation.

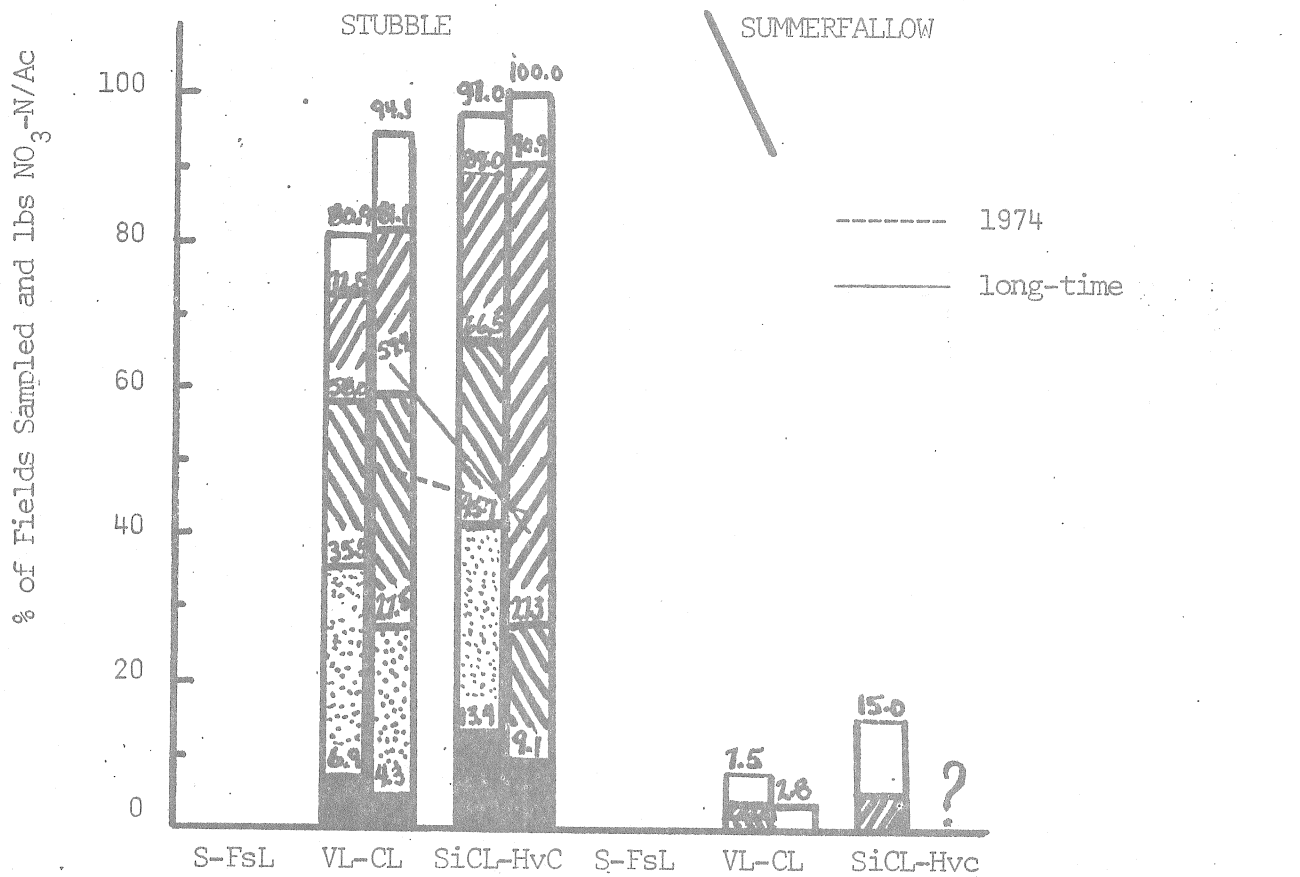

FIGURE 11. The average NO_3-N content to 24" and degree of nitrogen deficiency in Thick Black soils of Saskatchewan in relation to surface texture. The left-hand column in the pair represents the long-time average and the right-hand column the 1974 situation.

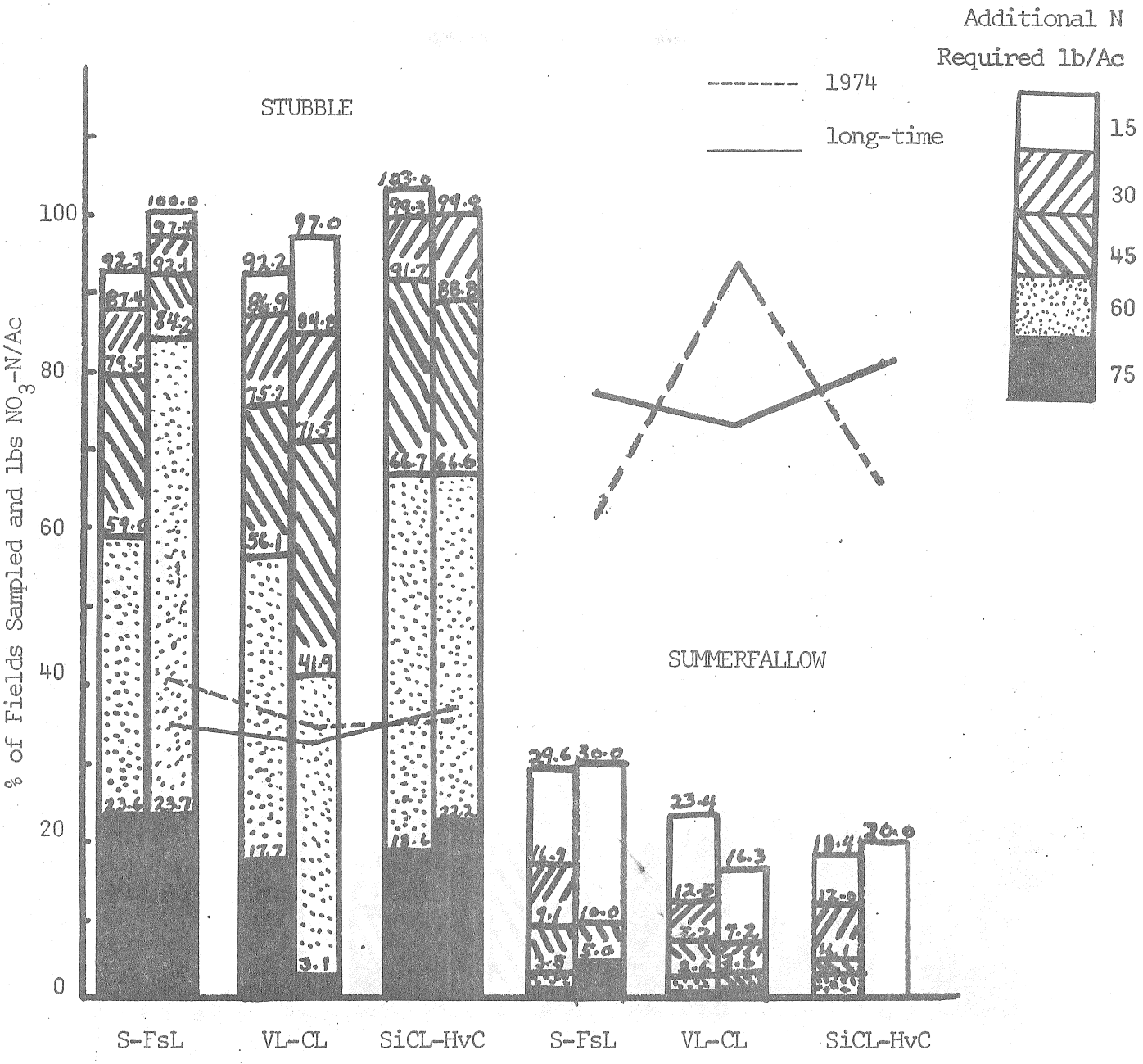

FIGURE 12. The average NO_3-N content to 24" and degree of nitrogen deficiency in Gray Black soils of Saskatchewan in relation to surface texture. The left-hand column in the pair represents the long-time average and the right hand column the 1974 situation.

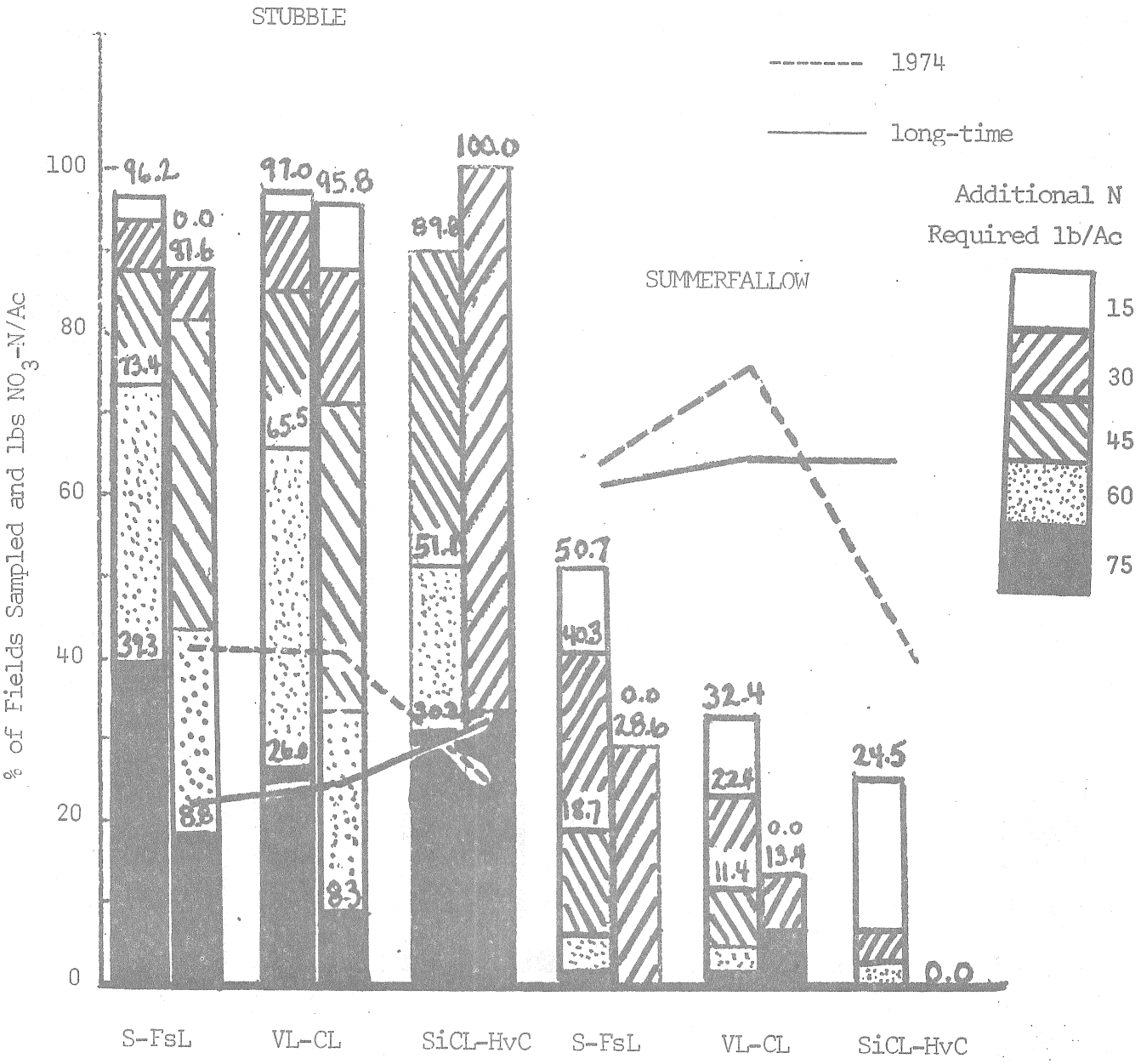

FIGURE 13. The average NO_3-N content to 24" and degree of nitrogen deficiency in Gray soils of Saskatchewan in relation to surface texture. The left-hand column in the pair represents the long-time average and the right-hand column the 1974 situation.

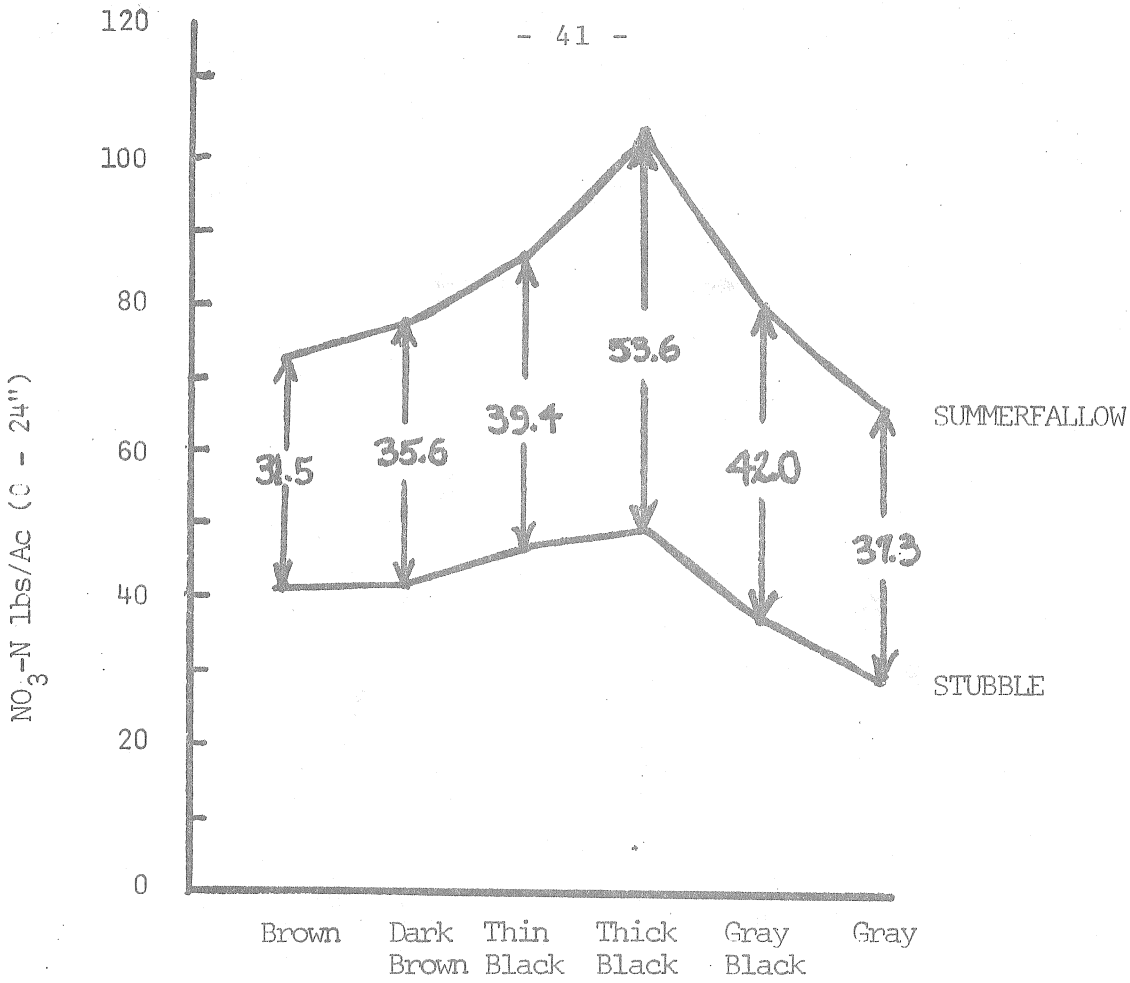

FIGURE 14. Net mineralization of nitrogen in Saskatchewan soils as determined by apparent differences between summerfallow and stubble NO_3-N levels (1966 to 1974).

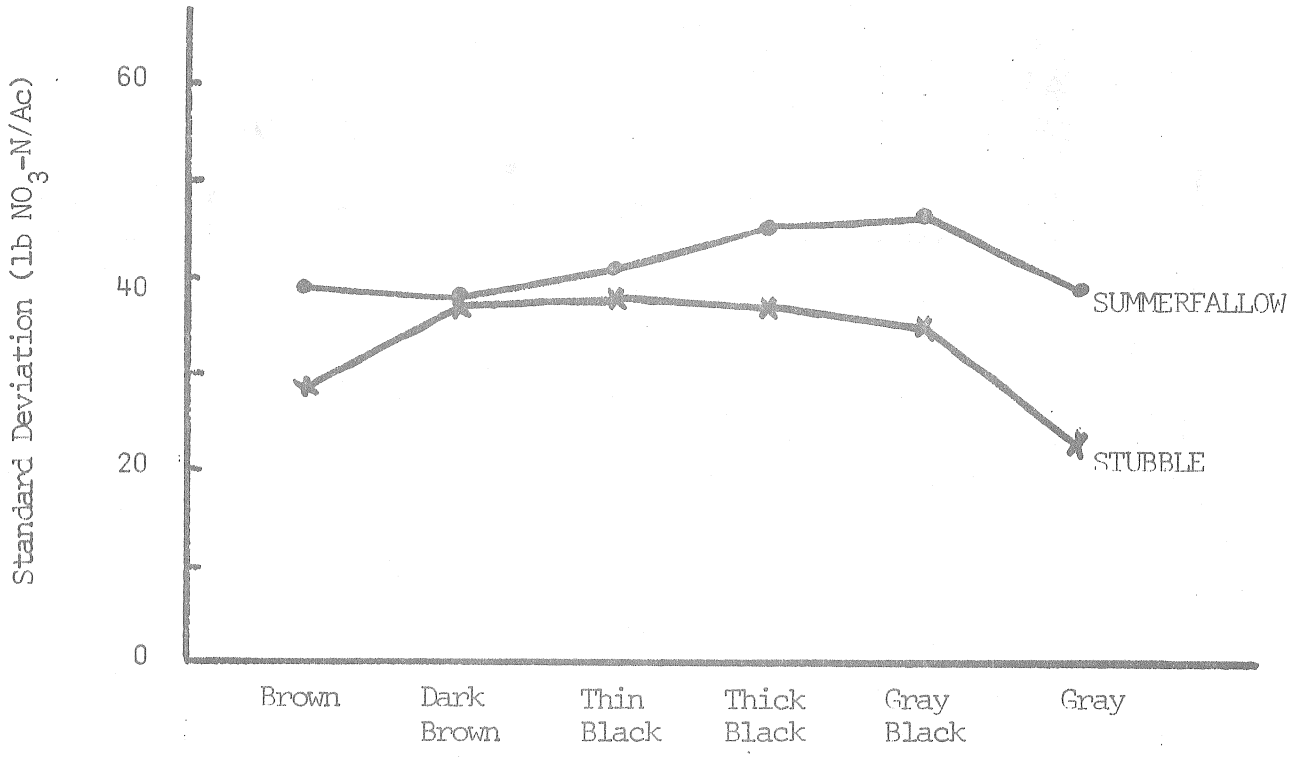

FIGURE 15. The mean standard deviation of mean NO_3-N levels to 24" in Saskatchewan soils in the period 1966 to 1974.

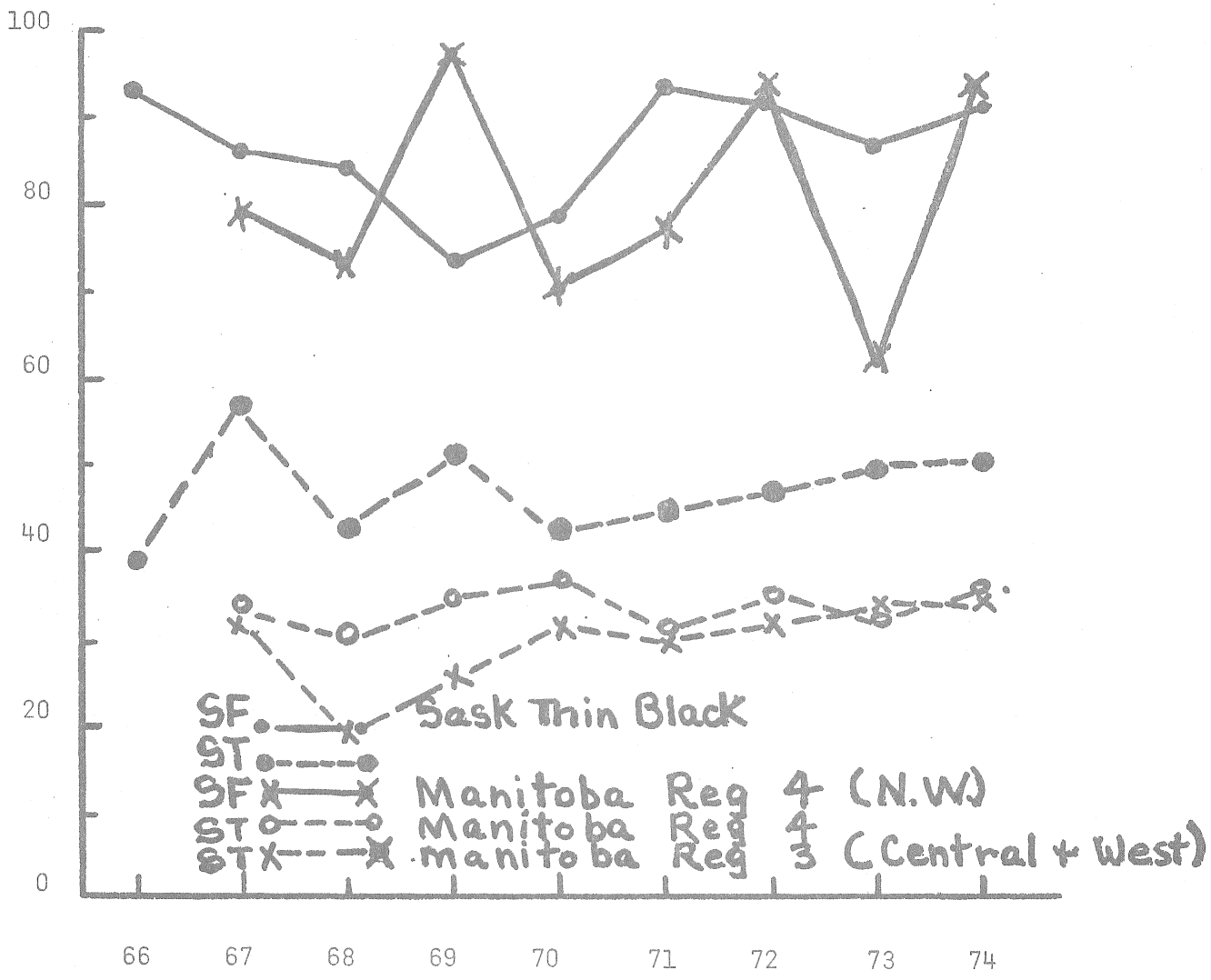

FIGURE 16. Relative NO_3-N levels in summerfallow fields in the Black soil zone of Saskatchewan and Manitoba.